

**AQMAU reference:** AQMAU-C2057-RP01

**Project title:** Kingmoor Energy Recovery Facility (ERF)

**Permit reference:** EPR/SP3609BX/A001

**Work title:** Audit of Air Quality and Human Health Assessment

**Date requested:** 14<sup>th</sup> May 2020

**AQMAU response date:** 6<sup>th</sup> October 2020

AQMAU recommendation	Conditions / Noted
<ul style="list-style-type: none"> <li>The applicant's conclusions regarding human health can be used for permit determination.</li> </ul>	<ul style="list-style-type: none"> <li>Contributions from the proposed ERF are unlikely to exceed any Environmental Standard set for the protection of human health.</li> <li>Predicted risks as a consequence of dioxins and furan emissions are well within the screening criteria for the protection of human health.</li> <li>Modelled emissions from the facility correspond to the Best Available Techniques Associated Emission Levels (BAT-AELs) from the Reference Document on the Best Available Techniques (BREF) published in 2019.</li> </ul>
<ul style="list-style-type: none"> <li>The applicant's conclusions regarding the River Eden Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI) may not be appropriate for permit determination. We therefore recommend the permitting officer consults with a habitats lead considering applicant's ecological interpretation of the impacts. Provided a Natural England consultation would be needed applicant's predictions can be used, indicatively.</li> </ul>	<ul style="list-style-type: none"> <li>Results from our audit indicate that there is the potential for the site to make a significant contribution to exceedances of the annual Ammonia critical level, Nitrogen deposition critical load and Acid deposition critical load at the River Eden SAC and SSSI. At locations of the ecological site, process contributions are not insignificant where backgrounds are already exceeded.</li> <li>The consultant presents an ecological interpretation of the impacts at the River Eden designated site and concludes that the effect is "not significant" due to the habitats present at the locations where PCs are not insignificant.</li> </ul>

**Detailed response and evidence starts on Page 2.**

## 1 Summary of work request

- 1.1 The National Permitting Service Installations Team asked the Air Quality Modelling and Assessment Unit (AQMAU) to audit the Air Quality Assessment (AQA)<sup>1</sup>, Human Health Risk Assessment<sup>2</sup> (HHRA) and Abnormal Emissions Assessment<sup>3</sup> of the Kingmoor Energy Recovery Facility (ERF).
- 1.2 The assessments support the permit application EPR/SP3609BX from Fortum Carlisle Limited (the applicant). Fichtner Consulting Engineers Limited (the consultant) undertook the assessments on behalf of the applicant.
- 1.3 The ERF facility will process waste at a capacity of up to 250,000 tonnes per annum. The technology will be based on conventional thermal incineration comprising moving grate furnace, steam boiler and turbine generator to produce electricity and the potential to recover waste heat.

## 2 Conclusions that lead to AQMAU's recommendations

2.1 The applicant concludes:

- For all pollutants, either the Process Contributions (PCs) are insignificant or the Predicted Environmental Concentration (PEC) is well below the environmental standards for air at all human receptors.
- For all pollutants, impacts at ecological receptors are screened out, with the exception of the River Eden SAC and SSSI. Further assessment of the impact, presented in "Ecological Interpretation of the AQA"<sup>4</sup> concludes the effect is not significant.
- Abnormal emissions will not give rise to an unacceptable impact on air quality.
- Cumulative emissions with relevant installations will not give rise to an unacceptable impact on air quality.
- The impact of dioxin and furan and dioxin-like PCB emissions are not significant.

2.2 We have audited the applicant's air quality assessment and have made observations on their methodology and assumptions. We have conducted our own check modelling and sensitivity analysis to our observations. As a result, we find that:

- For all pollutants, either PCs screen out as insignificant or PECs are below the Environmental Standard (ES) at relevant human receptors.
- Abnormal emissions will not have a significant impact on air quality.
- Cumulative emissions with relevant installations will not have a significant impact on air quality.
- The impact of dioxin and furan and dioxin-like PCB emissions are not significant.
- Concentrations of all pollutants fall below the critical levels at all relevant ecological sites, with the exception of ammonia at the River Eden SAC and SSSI where PCs are predicted to be over 1% of the critical level of 1µg/m<sup>3</sup> and backgrounds are already exceeding, therefore there is the potential for significant impact.

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<sup>1</sup> Kingmoor Energy Recovery Facility Environmental Permit Application. Air Quality Assessment (Fichtner Consulting Engineers Ref: S2856-0320-0009SMN Revision No: Issue 2) January 2020.

<sup>2</sup> Kingmoor Energy Recovery Facility Environmental Permit Application. Human Health Risk Assessment (Fichtner Consulting Engineers Ref: S2856-0320-0010SMN Revision No: 0) December 2019.

<sup>3</sup> Kingmoor Energy Recovery Facility Environmental Permit Application. Abnormal Emissions Assessment (Fichtner Consulting Engineers Ref: S2856-0320-0012SMN Revision No: 1) December 2019.

<sup>4</sup> Kingmoor Energy Recovery Facility Environmental Permit Application. Ecological Interpretation of AQA (Argus Ecology Ref: 19-078 Revision No: 1.0) December 2019.

- Nutrient nitrogen and acid deposition PCs at the River Eden SAC and SSSI are predicted to be over 1% of the critical loads and PECs are already exceeding, therefore there is the potential for significant impacts.
- The location of maximum impact on the River Eden SAC and SSSI occurs where the main habitat feature is “water courses of plain to montane levels”. It is therefore possible that the critical level of 3 µg/m<sup>3</sup> for ammonia is more appropriate for these locations. If this was to be used, the PC would be just over 1% (1.4%) and backgrounds are already at 100% (3 µg/m<sup>3</sup>). There are no critical loads available for water courses for either nutrient nitrogen or acid deposition for this feature. It is noted that the ecological interpretation of the AQA has concluded no likely significant effects on the River Eden SAC and SSSI based on these predicted impacts<sup>5</sup>.

2.3 Therefore, although we agree with the applicant’s conclusions with respect to human health receptors, we do not agree with the applicant’s conclusions for ecological receptors and recommend site specific advice should be sought, in particular for the ammonia, nitrogen and acid deposition impacts at the River Eden SAC and SSSI.

### 3 Evidence for recommendations

#### Air quality impact assessment

3.1 The applicant used ADMS version 5.2 air dispersion modelling software and five years of meteorological data observed at Carlisle airport between 2006 and 2010, located approximately 23 km northeast the facility. This station is likely to be reasonably representative of the meteorological conditions at the site. As shown in the wind rose presented in figure 6 of the air quality assessment, the met data used by the consultant shows that channelled south westerly winds are dominant. We have performed sensitivity to our own data observed at Carlisle.

3.2 Stack parameters and emission rates are presented in tables 17 and 18 of the consultant’s report. We have a number of observations:

- The consultant’s modelled emissions presented in table 18 correspond to the Best Available Techniques Associated Emission Levels (BAT-AELs) from the Reference Document on the Best Available Techniques (BREF) published in 2019<sup>6</sup>. These are lower and therefore more conservative than the Emission Limit Values<sup>7</sup> (ELVs) from the Annex VI Part 3 Waste Incineration of the Industrial Emissions Directive<sup>8</sup> (IED). We were able to replicate their emission rates for the pollutants.
- The consultant has modelled Benzo[a]Pyrene (BaP) using an emission concentration of 0.105 µg/Nm<sup>3</sup>. We note that the maximum measured BaP concentration mentioned in the annex 8 of the BREF 2019 is 0.4 µg/Nm<sup>3</sup> and have tested sensitivity to this.
- The consultant presents metal emissions assuming that they would emit at the maximum concentrations presented in the IED as Step 1 and then, where the PCs are predicted to be not insignificant, assumed that they would emit at the maximum

<sup>5</sup> Kingmoor Energy Recovery Facility Environmental Permit Application. Ecological Interpretation of AQA (Argus Ecology Ref: 19-078 Revision No: 1.0) December 2019.

<sup>6</sup> Neuwahl, F., Cusano, G., Gómez Benavides, J., Holbrook, S. and Roudier, S. Best Available Techniques (BAT) Reference Document for Waste Incineration: Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control), EUR 29971 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-12993-6 (online), doi:10.2760/761437 (online), JRC118637.

<sup>7</sup> ELVs or any emission concentration mentioned in this report are at reference conditions of 273.15K, 101kPa, 0% moisture and 15% oxygen contents.

<sup>8</sup> DIRECTIVE 2010/77/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 24 November 2010 on industrial emissions.

concentrations presented in table A1 of our Metals Guidance<sup>9</sup>. We agree with this approach.

- 3.3 Airflow around buildings may create zones of turbulence and downward mixing on the lee side. To account for the downwash effect, the consultant modelled three structures as shown in table 20 of their air quality assessment. In our analysis, only the boiler house is likely to contribute to downwash effect due to its location and height relative to the stack. There is a level of uncertainty in calculating the building downwash within the modelling software. In order to understand these uncertainties, we have conducted sensitivity to the omission of buildings.
- 3.4 The consultant has modelled assuming that the site operates continuously (8,760 hours per year). The facility has a design availability of 8,000 hours operation per year.
- 3.5 In order to represent the dispersion site, the consultant modelled a 6km by 6km grid with a 60 m resolution. We believe this modelling grid is likely to capture maximum predictions.
- 3.6 The consultant included 15 discrete receptor locations presented in table 15 of the AQA to represent human exposure, designated as R1 to R15. We believe these receptors are likely to capture maximum predictions at human health receptors. Receptors R3 to R6 are located within the Carlisle City Council "A7" Air Quality Management Area (AQMA), located approximately 1.5 km east of the site and designated for annual mean NO<sub>2</sub>.
- 3.7 The topography is flat close to the plant, however there are gradients above 1 in 10 within approximately 1 km of the facility where there are locations of exposure. Therefore, we consider that terrain is likely to have an effect on the dispersion of pollutants. The consultant did not assess the impact of terrain. We have performed sensitivity modelling with and without terrain from Ordnance Survey data.
- 3.8 There are four Air Quality Management Areas (AQMA) designated by Carlisle Council located between approximately 1.5km and 4.5km of the facility. These have been designated for historically exceeding the annual NO<sub>2</sub> Environmental Standard. The consultant's background concentrations summarised in table 14 were obtained from a number of different sources including monitoring and national mapping. We have reviewed all background concentrations, with particular focus on recorded values presented in the Annual Status Report of Carlisle City Council<sup>10</sup> and Air Defra website<sup>11</sup>.
- 3.9 Maximum Process Contributions (PCs) are presented in tables 26 to 35. The consultant presents impacts at sensitive receptors when PCs are not insignificant at grid locations. We note that:
- The consultant's annual mean NO<sub>2</sub> PCs predicted at the receptors located within the AQMA are up to 1.8% of the Environmental Standard, however, PECs are less than 70%. Therefore, impacts are predicted to be not significant.
  - Annual PCs for Chromium (VI) at the grid are over 1% and PECs are over 100% using both the IED and metals guidance emission rates. However, the consultant has not presented impacts of Chromium (VI) at relevant receptor locations. We have considered this in our checks.
  - Consultant's predictions indicate that PCs are either insignificant or PECs are below ES.
- 3.10 The area is relatively industrial and the consultant acknowledges a number of facilities surrounding the facility. The consultant modelled the Kingmoor Power Limited gas

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<sup>9</sup> Releases from Waste Incinerators – Guidance on assessing group 3 metal stack emissions from incinerators. Version 4. Environment Agency, Jun 2016.

<sup>10</sup> Air Quality Annual Status Report (ASR) Carlisle City Council, November 2019

<sup>11</sup> Air Defra Automatic Monitoring data available at <https://uk-air.defra.gov.uk> [Accessed August 2020]

powered peaking plant, located approximately 800 m north east of the facility with parameters presented in table 43, assuming that its contribution might not be incorporated in the baseline ambient air levels. We have evaluated this in our checks, checking years of operation and the potential for any additional emissions to air that are not included in the background concentrations.

- 3.11 In accordance with Article 46 (6) of the IED, the facility would be permitted to operate unabated above ELVs for a continuous period of no more than 4 hours and up to 60 hours per year, thus short-term impacts are of most concern during abnormal operations. The consultant provided the concentrations used to derive abnormal emissions in table 1 and table 2 of the abnormal emissions assessment. They state that these emission levels are based on measured data from a comparable facility. The Consultant's predictions at the grid for abnormal operations are presented in table 3 to table 7 which show that PCs are either insignificant or PECs are below the ES.

### Human Health Risk Assessment

- 3.12 The consultant has completed a HHRA using the Industrial Risk Assessment Program - Human Health (IRAP-h View) to assess the potential effects on human health due to the intake from diet and potential inhalation of dioxins, furans and dioxin-like PCBs. The HHRA applies approaches to the quantification of health effects from predicted pollutant concentrations published by the United States Environmental Protection Agency (US EPA) Human Health Risk Assessment Protocol<sup>12</sup> (HHRAP). Tolerable Daily Intake<sup>13</sup> (TDI) value published by the UK Committee on Toxicity (COT) have also been used where appropriate for the quantification of health effects at selected receptors.
- 3.13 The consultant disregards the ingestion of fish as a potential pathway stating that "recreational fishing is likely to be very small" implying that residents are unlikely to derive a large proportion of their diet from locally-caught fish. However, there is no mention to fish ingestion due to any nearby fish farm. The Environment Agency has agreed to a position with Public Health England (PHE) that a metals assessment is only needed if fish consumption is a significant pathway; otherwise, the environmental standards for metals are protective for human health. We have consulted a number of sources to investigate potential fish intake from members of the public<sup>14</sup> and agree that the ingestion of fish is unlikely to be a pathway.
- 3.14 The consultant's congener profile is shown in table 6 of the HHRA report. Their mass emissions for each congener in terms of Toxic Equivalent (I-TEQ) have been calculated on the basis of the Her Majesty's Inspectorate of Pollution (HMIP) 1996 measured concentrations and derived congener splits, factored by the Toxic Equivalent Factors (TEF) and scaled up to meet the BAT-AEL emission limit of 0.04 I-TEQ ng/Nm<sup>3</sup> for dioxins and furans. We were able to replicate the applicant's emission rates. We have performed sensitivity to our own worse-case emission rates derived from operator self-monitoring data (2008-2012).
- 3.15 Their predicted maximum contribution of the COT TDI value of 2 pg WHO-TEQ/kg(BW)/day is below 10% insignificance criterion suggested by PHE. We have conducted our own HHRA screening, taking into account a lower tolerable daily intake of approximately 0.29 pg WHO-TEQ/kg(BW)/day based on the tolerable weekly intake (TWI) of 2 pg WHO-TEQ/kg(BW)/week. This level, established by the European Food

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<sup>12</sup> Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, EPA 2005.

<sup>13</sup> Tolerable Daily Intake (TDI) of 2 picogrammes toxic equivalent (TEQ) of dioxins and dioxin-like PCBs per kilogramme human body weight per year.

<sup>14</sup> The Centre for Environment, Fisheries and Aquaculture Science (CEFAS) website available at <https://cefas.cefastest.co.uk/eu-register/?filter=> [Accessed on April 2020]

Safety Authority panel on Contaminants in the Food Chain (CONTAM), has been accepted by the UK COT.

### **Ecological Assessment**

- 3.16 The consultant assessed impacts at seven ecological sites. Five of these have been identified as being within Environment Agency guidance<sup>15</sup> distance criteria of 2 km for local nature sites and Sites of Special Scientific Interest (SSSI) and 10 km for Special Protection Areas (SPA), Special Areas of Conservation (SAC) and Ramsar sites. The additional two sites are the Harker Moss and Rockliffe Moss Local Wildlife Sites (LWS), which are slightly outside of the 2 km screening distance, however have been included at the request of the EA during consultation for the planning application for this facility.
- 3.17 The consultant's critical level predictions and deposition rates are presented in tables 36 to 42 of the AQA. We have reviewed critical levels, critical loads and background values presented using the APIS website<sup>16</sup>. Their predictions indicate that;
- PCs for ammonia are over 1% of the critical level of 1 µg/m<sup>3</sup> (maximum of 4.3%) and backgrounds are already exceeding (300%) for the River Eden SAC and SSSI.
  - PCs for nitrogen deposition and acid deposition are over 1% of the relevant critical loads (2.45% and 11.57%, respectively) and backgrounds are already exceeding for the River Eden SAC and SSSI. Ammonia accounts for approximately 75% of the contribution to the nutrient nitrogen PC.
  - The consultant claims that exceedances for both ammonia and nitrogen and acid deposition are predicted for a small area of the total designation of the River Eden. Further details of the impacts at this location are discussed in Section 2.2.
  - PCs are either insignificant or PECs are below the relevant critical levels for all other pollutants and receptors.

### **AQMAU check modelling**

- 3.18 We carried out detailed check modelling using ADMS 5.2. Our checks were based on the consultant's modelling files and includes sensitivity and conclusions to:
- 5 years of meteorological data observed at Carlisle 1993, 1994, 1996, 1997 and 2009 (2009 data extracted at the Carlisle meteorological station from Numerical Weather Prediction data) (refer to point 3.1). Carlisle meteorological station is located at approximately 23 km from the site.
  - Chromium VI emitting at the maximum emission concentration specified in Table A1 of the metals guidance (refer to point 3.2).
  - BaP emitting at the maximum emission limit value specified in the new BREF annex 8 of 0.4 µg/Nm<sup>3</sup> (refer to point 3.2).
  - With and without the inclusion of the applicant's modelled buildings (refer to point 3.3).
  - Terrain data in National Transfer Format (NTF) from Ordnance Survey (refer to point 3.7).
  - Review of additional sources with emissions to air that may or may not be included in the background data (refer to point 3.10).
  - HHRA screening based on worst-case congener profiles (refer to 3.14).
  - Sensitivity to the lower TDI of 0.29 pg WHO-TEQ/kg(BW)/day based on a tolerable weekly intake of 2 pg WHO-TEQ/kg(BW)/week (refer to 3.15).

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<sup>15</sup> Environment Agency and Department for Environment, Food & Rural Affairs, Environmental management-guidance: Air emissions risk assessment for your environmental permit. 1 March 2016, [www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit](http://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit) [Accessed on February 2019]

<sup>16</sup> Air Pollution Information System [www.apis.ac.uk](http://www.apis.ac.uk) [Accessed on February 2019]

- 3.19 Although we do not agree with the consultant's absolute numerical predictions, we agree with applicant's conclusions regarding normal and abnormal operations. For all pollutants, the ERF facility is likely to have insignificant PCs or the PECs are unlikely to exceed any environmental standard. Our checks indicate that impacts at the AQMAs are unlikely to be significant. Similarly, BaP PCs at human receptors are insignificant.
- 3.20 The contribution from the facility is unlikely to cause significant pollution at any local nature site. There is the potential for significant impacts at the River Eden SAC and SSSI for ammonia, nutrient nitrogen and acid deposition. The extension of exceedances that we have predicted are similar to those predicted by the applicant. The applicants numerical values can therefore be indicatively used if consultation with Natural England is required.
- 3.21 Our HHRA screening check calculations of dioxins, furans and dioxin-like PCB intakes, indicate that the PC is likely to be less than 10% of the COT-TDI and a more stringent TDI of 0.29 pgWHO-TEQ/kg(BW)/day.
- 3.22 In our judgement, only the nearby Kingmoor Power Limited gas peaking (with an operation starting in 2019, according to our records) might be the only facility that is not included in the background. However, our checks indicate that the two facilities are unlikely to have a significant cumulative effect, as the plumes only overlap to affect receptors at specific locations for relatively infrequent wind directions. The rest of the facilities in the surrounding area have been either operating for a relatively long time, or in locations that are unlikely to coincide with the plume from the ERF.